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COMPLETE SPECIFICATION

Methods of Manufacturing Articles from Plastic Material Provided with Pictures, Decorations or Letters

We, PLASTOMATIC LIMITED, a British Company, of 17, Winchester Road, London, N.W.3, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method of manufacturing, by the powder sintering method, thermoplastic articles which have on their outer walls coloured or non-coloured pictures, decorations, letter or wordings.

According to this method a powdered or otherwise finely divided thermoplastic material, for example polyethylene, is provided in a hollow mould in a quantity so that the inner wall of the mould is entirely covered with a layer of a sufficient thickness to be able to shape the desired wall thickness of the article to be manufactured, while the temperature of the wall of the mould is insufficient to cause the particles of plastic material to sinter. Then the outer wall of the mould is heated at a predetermined temperature and for a predetermined period, the layer of plastic material remaining stationary with respect to the inner wall, as a result of which the particles of plastic material sinter together on this inner wall to form a firm layer of the desired thickness. Then the mould is cooled and the article is removed from it.

Pictures, decorations or wordings have been provided on articles of thermoplastic material manufactured according to this technology after these articles are finished. The printing of pictures or wordings on these articles is very time-consuming and expensive as compared with manufacture proper of these articles.

As a matter of fact, surfaces of plastic material in general require a special pretreatment for printing which, as is also the case with the actual printing of the surfaces of shaped articles which are often curved and arched, frequently requires special equipment.

According to the present invention, a method of manufacturing thermoplastic articles, the surface of which is provided with decoration, wording or the like, according to the powder sintering method, is characterised in that a film or plate of plastic material whether or not provided with decoration, wording or the like and manufactured from a material which, within the melting range of the thermoplastic material from which the article to be shaped is manufactured, is capable of forming a physical or chemical bond with this material, is provided against the inner wall of the mould in which the article of thermoplastic material will be manufactured, after which the thermoplastic article is manufactured at a temperature which is sufficient to effect the formation of the bond of the plastic materials.

Using the method according to the invention, articles of plastic material having the desired picture or figure can be manufactured in one operation. For this purpose, first the film material is selected which is most suitable for the end in view as regards kind, colour, and thickness and which meets the condition of fusing or otherwise forming a rigid connection, at the temperature of processing the material from which the article is manufactured, with this latter material. On film strips of the type of film found to be the most suitable, the picture is provided in the size and colour or colours desired. Before processing, the film strips are adapted, in shape and size, to the end in view and to the size and the shape of the mould in which the article will be manufactured. This film provided with a figure, picture or wording is then caused to adhere to the inner wall of the mould, either with its printed or with its unprinted side facing said wall, after which the desired article is manufactured in the mould

[Price 4s. 6d.]

pastes a film strip on mold surface & bonds film strip on molded article

at the normal processing temperature and removed from the mould, if desired after cooling.

Adhesion of the film to the wall of the mould may be effected without adhesives if the film is sufficiently thin and the surface of the inner wall of the mould is polished. In many cases it is preferable to use an adhesive to attach the film to the wall of the mould. The adhesive may be any substance or mixture which is capable of withstanding the processing temperature at which the article of plastic material is manufactured, keeping the printed film in an immovable manner and smoothing against the inner wall of the mould both at the beginning and during the manufacture, and having no or only a slight adhesion against the inner wall of the mould after the manufacture.

However, if desired, the film layer can be formed on the inner surface of the bottom or side wall of the mould. Thus, for example one or more coloured powders are strewed, whether or not with the use of a design, on the inner surface of the bottom of the mould, or a decoration is painted thereon with ink, whereafter a thin layer of thermoplastic powder is provided over it. The mould is then heated until the thermoplastic powder is fused to an uninterrupted layer, cooled and the article manufactured. To form such a film e.g. of coloured thermoplastic powder against the walls of a mould, these walls first can be painted with an adhesive. Another way of producing the decoration is first to provide a thermoplastic film on the inner wall of the mould by placing therein a preformed uncoloured film or strewing uncoloured thermoplastic powder in the mould and heating the mould so that the powder fuses and forms a film. The coloured powder to form the decoration is strewn on the uncoloured film, the mould being warmed if a preformed film is used, so that the film is sticky and the coloured powder adheres to it, or the coloured powder being applied before the uncoloured film cools if the latter is formed *in situ*.

It has appeared that the known silicon oils and silicon fats are adhesives which meet the requirements imposed.

Other useful adhesives are solid hydrocarbons or pasty mixtures of solid and liquid hydrocarbons which are miscible with a liquid monomer or oligomer of the processed plastic materials and are processed with them to a smooth paste, or liquid hydrocarbons or mixtures thereof which are miscible with the processed plastic materials and are processed with one or both to a pasty mass which meets the above conditions. For the manufacture of polythene articles and for providing polythene films against the inner wall of the mould to be used, a mixture of 100 parts by weight of paraffin oil and 20 parts of polythene having a melt flow index of 20 has turned out to be very suitable. This adhesive also gave good results when processing polyvinyl chloride films, polyvinylidene chloride films and polyamide films.

The thickness of the film strips sometimes depends on the material from which the film is manufactured. Also films may be used which are composed of several layers of the same kind of plastic material or of various kinds of plastic materials, or of a plastic which is provided with a metal layer provided thereon either as a film or by spraying

The film may be mounted against the wall of the mould with its unprinted surface facing the wall, and, in the case of a suitable choice of the thickness of the film and the type of paint used, the desired picture or wording is clearly obtained on the surface of the article manufactured, even though the picture or wording is covered by a thin layer of plastic material which is rigidly connected to the wall of the article. The picture or wording will preferably be provided as a mirror image on the surface of the film strip. Using the method according to the invention it is now possible to produce, in one operation, articles of plastic material having a wording or figure which is protected from weather influences and chemical and mechanical damages by a thin layer of plastic material.

A polythene film which is provided with a wording or picture by means of one or more known heat-resistant sorts of ink, and which is attached in the desired position against the inner wall of the mould in accordance with the invention, is entirely incorporated in the outer wall after manufacturing the article and forms an assembly with it, the wording or picture having been made to engage the wall of the article in an entirely undamaged manner, without distortion or mis-shaping, in the position where the film has engaged the wall of the mould.

The temperature resistance is the most important property would should be met by the sorts of ink which are used for printing and colouring the surface of the film strips. The so-called "steam set" inks, obtainable on the market, composed on the basis of drying oil or resin oil combinations, frequently with the addition of a drying agent, or a drying substance known in graphical circles, have turned out to be suitable for printing films which are used in the method according to the invention.

The method according to the invention is very suitable for producing articles of plastic material coloured on the outer wall or articles of plastic material having a thin metal layer on the outer wall. For this purpose, a coloured film or a film provided with a metal layer is provided on the whole surface of the inner wall of the mould, in the latter case with the metal layer facing the wall of the mould, and

then the article of plastic material is manufactured.

It may be of advantage to use a film strip larger than is strictly necessary for providing the wording or the picture, so as to obtain a better attachment of the film against the wall of the mould during the manufacture of the article of plastic material and consequently prevent distortion or mis-shaping.

With the method according to the invention, many colour effects can be obtained. For example, the article of plastic material may be given a different colour from the film and the wording or picture may be punched in the film strip.

The invention will now be described more fully with reference to the following examples.

EXAMPLE I.

The entirely dry bottom and inner walls of a sheet steel tray, 20 cm long, 15 cm wide and 5 cm high, are evenly painted by means of a brush with a silicon oil (Bayer M 100). The bottom wall of this tray is then provided with a transparent film strip, 8 cm wide, 5 cm long and 0.075 mm thick, manufactured from high-pressure polythene. This strip contains a thoroughly dried-in wording in mirror image, printed with red "steam set" ink obtainable in the trade and capable of withstanding a temperature of approximately 350° C. The strip is carefully but still firmly and entirely smoothly pressed against the bottom wall of the tray, for example by means of a plug of wadding, so that the unprinted side faces the said bottom wall. After pressing, no air bubbles may be visible with the naked eye between the strip and the wall. Now the tray is filled with 250 g of polythene powder having a melt flow index of 2, a specific gravity of 0.919 and a maximum grain size of 0.4 mm, evenly distributed in the tray and slightly pressed. Then the tray is placed above the open shaft of an electric furnace which has a temperature of 350° C. The shaft of the furnace is entirely covered by the tray. After 10 minutes, the tray is removed from the furnace and the non-melted powder is shaken out of the tray. Then the tray is placed on the furnace for another 8 minutes. Then the mass has become transparent. The assembly is then allowed to cool in the open air for 4 minutes, the tray is held for a moment in a water bath of room temperature and then it is immersed in its enirety. The polythene plate formed with the incorporated film can be easily removed from the tray.

EXAMPLE II.

A a mould is used a round conically tapering tray of heat-resistant glass, 16 cm high, a diameter of the bottom of 10 cm and a diameter of the top side of 13 cm. Then a red coloured film strip of low-pressure polythene, 6.5 cm long, 6 cm wide and 0.05 mm thick, is manually applied against the wall. A decoration is punched in the film strip. The film strip, the temperature of which approximately corresponds to that of the mould tray, must entirely smoothly engage the wall of the tray. Then the tray is filled to the rim with yellow coloured low-pressure polythene powder having a melt flow index of 7. The powder is slightly pressed and the tray is suspended by its edge for 7 minutes in an electric shaft furnace having a temperature of 275° C. Then the non-sintered powder is shaken out of the tray and the latter is once again suspended for 3 minutes in the shaft of the furnace in the same manner. Then the assembly is allowed to cool in the open air first for 3 minutes, then suspended to the edge in water of 22° C. for 2 to 3 minutes and then immersed in the water. Finally, the polythene tray with the decoration sintered in yellow and red on the wall is removed from the glass tray.

EXAMPLE III.

As a mould is used a round, conically tapering sheet steel tray, 16 cm high, having a diameter at the bottom of 10 cm and a diameter at the top side of 13 cm.

At the position where a wording is to be provided on the wall of the article of plastic material, a surface of approximately 8×8 cm is painted by means of a brush on the wall of the sheet steel tray with an adhesive consisting of a mixture of monostyrene and polystyrene. This mixture has been obtained by mixing, with thorough stirring, 10 ml of liquid monostyrene with so much solid polystyrene that the volume of the mixture is 15 ml.

On the wall of the sheet steel tray covered with adhesive, a blue coloured polystyrene film strip of 6×6 cm, on which wording provided no yellow "steam set" printing-ink covers approximately 2×2 cm of the surface, is caused to adhere with the printed side against the wall of the tray. The thickness of the film strip is 0.06 mm. The sheet steel tray is then filled to the rim with polystyrene powder and slightly pressed. The further treatment takes place as described in Example II. The temperature of the furnace is 350° C. the sintering time 10 minutes.

EXAMPLE IV.

The wall of a sheet steel tray having dimensions as described in Example III is covered over a surface corresponding to the size of the film strip with an adhesive consisting of a mixture of paraffin oil and polythene having a melt flow index of 20. This mixture is obtained by heating 100 ml of paraffin oil to approximately 170° C. and homogeneously mixing in it 15 g of polythene.

On the part of the wall covered with adhesive, a transparent film strip laminated from

three layers is provided in a completely smooth manner. Air bubbles, if any, are brushed away. The film strip consists of two layers of polythene with the interposition of a layer of nylon 11. On the layer of nylon 11, a wording is printed with "steam set" ink. The film is applied with the printed side against the wall of the mould. The thickness of the film is 0.35 mm.

The layers of the film strip may also be applied one after another and on each other against the wall. As an adhesive, the paraffin-oil-polythene mixture is used.

The sheet steel tray is then filled to the rim with polythene powder having a melt flow index of 7, after which sintering is carried out as described in Example II. The sintering temperature amounts to 350° C., the sintering time is 7 minutes.

EXAMPLE V.

The manufacture of the article of plastic material is carried out as described in Example III.

As an adhesive is used a silicon fat. The film strip is a cellulose-acetobutyrate film metallized with aluminium dust, in which film a wording is punched. The weight of the film is 72 g/m².

The article is manufactured with cellulose-acetobutyrate powder. The sintering temperature amounts to 300° C., the sintering time is 8 minutes.

EXAMPLE VI.

The manufacture of the article of plastic material is carried out as described in Example III.

As an adhesive is used a mixture of paraffin oil and polythene as described in Example IV.

A film strip is used of polypropene (melt flow index 10), having a thickness of 0.05 mm and an aluminium foil of 0.05 mm thick. A wording is punched in the aluminium foil strip. The polypropene film strip is applied against the wall of the sheet steel tray. As described in Example IV, the aluminium foil strip is provided against this polypropene film strip.

The article is manufactured from high-pressure polythene powder having a melt flow index of 7. The sintering temperature amounts to 300° C. the sintering time is 5 minutes.

EXAMPLE VII.

The manufacture of the article of plastic material is carried out as described in Example III. As an adhesive is used a mixture of paraffin oil and polythene as described in Example IV.

A red film of high-pressure polythene, 0.03 mm thick, is used. The foil strip of said material is attached to the whole wall of the sheet steel tray. A wording is punched in the strip.

The article is manufactured from the polymer of 11-aminoundecanic acid (nylon11). The sintering temperature is 200° C., and the sintering time is 7 minutes.

EXAMPLE VIII.

The manufacture of the article is carried out as described in Example III. As an adhesive is used the mixture of paraffin oil and polythene described in Example IV.

A film strip manufactured from a copolymer of 85% vinylidene chloride and 15% vinyl chloride, 0.08 mm thick, printed in mirror image with "steam set" ink, is provided, with the unprinted side against the wall of the sheet steel tray. The article is sintering from powder of the same copolymer as the film strip. The sintering temperature is 165° C., and the sintering time is 12 minutes.

EXAMPLE IX.

The manufacture of the article of plastic material is carried out as described in Example III. The adhesive used is the mixture described in Example IV.

The film strip is a coloured terephthalic acid polyglycol ester film of 0.08 mm thick. The wording is punched in the strip. The article is manufactured from low-pressure polythene having a melt flow index of 12. The sintering temperature is 300° C. and the sintering time is 10 minutes.

EXAMPLE X.

The manufacture of the article is carried out as described in Example III. As an adhesive is used the mixture of paraffin oil and polyethylene described in Example IV. On the wall of the sheet steel tray covered with adhesive, a decoration of different colours in "steam set" ink is painted by means of a brush. Over it a thin layer of pulverised high-presure polyethylene is strewed, whereafter the tray is heated until the polyethylene powder is fused to a continuous layer. Then the tray is allowed to cool, for example in the open air, and filled to the rim with high-pressure polyethylene powder having a melt flow index of 20. After the powder is slightly pressed the further treatment takes place as described in Example II. The temperature of the furnace is 350° C., and the sintering time is 10 minutes.

WHAT WE CLAIM IS:—

1. A method of manufacturing thermoplastic articles, the surface of which is provided with decoration, wording or the like, according to the powder sintering method, characterized in that a film or plate of plastic material whether or not provided with decoration, wording or the like and manufactured from a material which, within the melting range of the thermoplastic material from which the

article to be shaped is manufactured, is capable of forming a physical or chemical bond with this material, is provided against the inner wall of the mould in which the article of thermoplastic material will be manufactured after which the thermoplastic article is manufactured at a temperature which is sufficient to effect the formation of the bond of the plastic materials.

2. A method as claimed in Claim 1, characterized in that a transparent polyethylene film provided with the desired decoration, wording or the like, in a mirror image is applied with its undecorated side against the inner wall of the mould by means of an adhesive compatible with both the polyethylene film and the moulding powder, after which the article of polyethylene is sintered and further treated.

3. A method as claimed in Claim 1 or 2, characterized in that adhesion of the film to the inner wall of the mould is effected by means of adhesive composed of a mixture of 100 parts of paraffin oil and 20 parts of polyethylene having a melt flow index of 20.

4. Shaped articles of plastic material provided with a decoration or wording when manufactured by the method according to one or more of the preceding claims.

5. A method of manufacturing decorated thermoplastic articles substantially as herein described.

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